*Zootaxa* 3586: 69–77 (2012)
www.mapress.com/zootaxa/


**Article**

ISSN 1175-5326 (print edition)
**ZOOTAXA**
ISSN 1175-5334 (online edition)

urn:lsid:zoobank.org:pub:6DA89886-FC03-4AB3-9908-9183AB46F9DC

# *Schistura tenebrosa*, a new species of loach from the Kwai Noi River system, Mae Khlong basin, Thailand (Teleostei: Nemacheilidae)

PUNNATUT KANGRANG[1,3], LAWRENCE M. PAGE[2] & F. WILLIAM H. BEAMISH[1]

[1]*Environment Science Program and Center of Excellence on Environmental Health, Toxicology and Management of Chemicals (ETM), Faculty of Science, Burapha University, Bangsaen, Chonburi, 20131, Thailand. E-mails: aui_rnband@hotmail.com, billbeamish@hotmail.com.*

[2]*Florida Museum of Natural History, Gainesville, Florida, 32611, USA. E-mail: lpage1@ufl.edu*

[3]*Corresponding author*

## Abstract

A new species of *Schistura* is described from the Kwai Noi, Mae Khlong basin, in the Thong Pha Phum District of Kanchanaburi Province in western Thailand. The species is distinguished from all other species of *Schistura* by a uniform dusky brown color pattern without marks on the dorsum or side of body and with many conspicuous supplementary neuromasts along the lateral line and on the head. It is further distinguished from other species of *Schistura* lacking marks on the body by its dark brown color, an incomplete lateral line extending only to beneath the dorsal fin, and the origin of the dorsal fin located above the origin of the pelvic fin. The species is small, reaching only 46.0 mm SL, 55.1 mm TL, and inhabits shallow gravel and rubble riffles in small streams.

**Key words:** loach, Cypriniformes

## Introduction

The taxonomy of *Schistura* was summarized by Kottelat (1990a) in his review of the loaches of Myanmar, Cambodia, Laos, Thailand, and southern Vietnam. Subsequently, six species have been described from Thailand (Kottelat 1990b; Vidthayanon 2003; Vidthayanon & Kottelat 2003; Bohlen & Ŝlechtová 2009; Plongsesthee *et al.* 2011), 50 from Laos (Kottelat 1998, 2000; Vidthayanon & Jaruthanin 2002), one from Myanmar (Bohlen & Ŝlechtová 2011), 16 from Vietnam (Freyhof & Serov 2001; Kottelat 2004; Nguyen 2005; Nguyen & Nguyen 2007), and one from Cambodia (Ou *et al.* 2011).

Among the currently recognized species of *Schistura* are only three that lack bars, stripes or other marks on the body and are more or less uniform in color. These are *S. atra*, *S. russa*, and *S. suber*. Recent collections from the Kwai Noi River system of the Mae Khlong basin in western Thailand contain a new species, described herein, also without bars or stripes on the body.

## Methods

Fishes were captured with a Smith-Root (Vancouver, WA, U.S.A.), model 15D electrofisher. After capture, specimens were killed by an overdose of methane tricaine sulfonate (>150 mg/l) and preserved, first in 10% formalin for 7 days and then in 70% ethanol for permanent storage. At most sites, water depth and velocity were measured and recorded as the average of 3–5 measurements made at approximately equal intervals across a transect located at about midlength. Velocity was measured with a propeller current meter (±0.1 cm/s) at middepth. Canopy was estimated visually and recorded as a percentage of complete cover. Regularly calibrated meters were used to measure temperature (±0.1 C), conductivity (±10 µS/cm), pH (±0.1) and dissolved oxygen (±0.01mg/l). Other chemical factors were measured as described in American Public Health Association (APHA) 1992, and Tongnunui & Beamish (2009). Elevation was measured with a Global Positioning System meter, GPS (±10 m).

*Accepted by R. Pethiyagoda: 16 Oct. 2012; published: 14 Dec. 2012*

Measurements, fin-ray counts, and counts of pores in the lateralis system followed Kottelat (1990a) except head length was measured from the posterior edge of the opercle to the tip of the snout, and body width was measured at the dorsal-fin origin. Measurements were made point-to-point with dial calipers to the nearest 0.1 mm. Scales on most of the body are deeply embedded and were not counted. Meristic counts for the holotype are indicated by an asterisk. Photographs were taken of live and freshly preserved specimens in the field using a Nikon D60 camera and of preserved specimens using a Visionary Digital (Palmyra, Virginia) with a Canon 5D camera at the Florida Museum of Natural History. Specimens examined are from the University of Florida (UF), National Inland Fisheries Institute, Bangkok (NIFI), U.S. National Museum of Natural History, Washington (USNM), Zoological Reference Collection, National University of Singapore (ZRC), and Burapha University (uncatalogued).

***Schistura tenebrosa*, new species**
(Figs. 1–4)

**Holotype.** UF 181417, 45.1 mm SL; Thailand, Kanchanaburi Prov., Thong Pha Phum, Mae Khlong basin, Kwai Noi River system, Pakkok River, 14º36'22"N, 98º28'14"E, 5 Dec. 2009, Punnatut Kangrang, Robert Beamish and Thanapoom Kongchaiya.

**Paratypes.** UF 181418, 10 ex., 33.2–46.0 mm SL; NIFI 4415, 3 ex., 43.6–45.4 mm SL; USNM 400923, 3 ex., 37.4–42.5 mm SL; ZRC 53100, 3 ex., 39.0–45.0 mm SL; same data as holotype. UF 181419, 4 ex., 36.3–44.6 mm SL; same locality as holotype, 5 Dec. 2009, Punnatut Kangrang, Robert Beamish and Thanapoom Kongchaiya. UF 181157, 1 ex., 28.8 mm SL; Thailand, Kanchanaburi Prov., Thong Pha Phum, Mae Khlong basin, Kwai Noi River system, Pakkok River system, Ban Huay Pousa, 14º38'0"N, 98º48'0"E, 20 Apr. 2011, Rungthip Plongsesthee, Randal A. Singer, and Larry M. Page. UF 181420, 4 ex., 42.6–45.9 mm SL; Thailand, Kanchanaburi Prov., Thong Pha Phum, Mae Khlong basin, Kwai Noi River system, Pracham Mai River, 26 Oct. 2010, Rungthip Plongsesthee**.**

**Paragenetype. (**UF 181418**):** GenBank JQ659026 (mitochondrial cytochrome *b*).

**Other material examined.** Burapha Univ. uncat., 8 ex., 32.0–43.8 mm SL; Thailand, Kanchanaburi Prov., Thong Pha Phum, Mae Khlong basin, Kwai Noi River system, Pakkok River, 14º36'52"N, 98º27’53"E, 4 Dec. 2009, Punnatut Kangrang, Robert Beamish and Thanapoom Kongchaiya.

**Diagnosis.** Member of genus *Schistura* as defined by Kottelat (1990a). Distinguished from all other species of *Schistura* by a uniform dusky brown color pattern without marks on dorsum or side of body (Fig. 1) and many conspicuous supplementary neuromasts along the lateral line and on the head. It is further distinguished from other species of *Schistura* lacking brown or black marks on body by its dark brown color, incomplete lateral line extending only to beneath dorsal fin, and origin of dorsal fin located above origin of pelvic fin.

**TABLE 1.** Morphometric data for *Schistura tenebrosa*. Data for holotype are included in range and mean.

| | holotype | range (N = 36) | mean± SD |
|---|---|---|---|
| Standard length (mm) | 45.1 | 32.0–46.0 | 41.5±4.0 |
| **Percentage of SL** | | | |
| Head length | 22.6 | 20.0–23.9 | 22.5±0.9 |
| Predorsal length | 57.0 | 50.9–61.3 | 55.0±2.4 |
| Snout length | 9.1 | 7.0–10.2 | 8.6±0.7 |
| Prepelvic length | 51.0 | 47.7–55.6 | 50.6±1.9 |
| Preanal length | 79.8 | 64.2–79.8 | 73.7±4.5 |
| Body depth | 15.3 | 12.7–18.0 | 14.5±1.4 |
| Body width | 11.8 | 9.1–14.1 | 11.8±1.1 |
| Caudal-peduncle depth | 13.3 | 11.4–14.3 | 12.9±0.8 |
| Caudal-peduncle length | 14.6 | 11.9–16.6 | 14.8±1.2 |
| Pectoral-fin length | 16.0 | 15.2–17.9 | 16.6±0.8 |
| Pelvic-fin length | 15.1 | 14.3–17.2 | 15.7±0.8 |
| **Percentage of head length** | | | |
| Eye diameter | 9.8 | 4.7–9.8 | 7.6±1.3 |
| Interorbital width | 28.4 | 23.7–35.6 | 27.5±2.4 |


**FIGURE 1.** *Schistura tenebrosa*. (A) UF 181417, holotype, 45.1 mm SL, lateral, ventral and dorsal views; (B) UF 181418, paratype, 33.2 mm SL, lateral view. Scale bars = 10 mm.

**Description.** Body shape and color are shown in Figure 1. Morphometric data are in Table 1. Largest specimen is a female, 46.0 mm SL, 55.1 mm TL (UF 181418).

Body compressed, slender, depth slightly greater than body width. Body depth nearly uniform throughout, slightly deeper at dorsal-fin origin than at caudal peduncle. Profile of snout and head moderately pointed. Snout moderately pointed in dorsal view. Head depressed; eye small, oval, longer than high, near dorsal profile, directed dorsolaterally.

Dorsal-fin origin above origin of pelvic fin. Pectoral fin reaching over half distance from pectoral-fin base to pelvic-fin base. Pelvic fin overlapping anus, reaching over half distance from pelvic-fin base to anal-fin origin. Axillary pelvic lobe present. Anal fin not reaching caudal fin. Margins of dorsal and anal fins convex. Caudal fin emarginate. Small adipose crest on dorsal margin, none on ventral margin of caudal peduncle.

Body scaled, except scales absent on nape and on venter before pelvic fins. Scales embedded on anterior side, becoming less so near vertical from origin of dorsal fin. Lateral line incomplete with 18–30 (mean = 24.1; SD = 3.1; mode = 23) pores (n = 35), usually ending before origin of dorsal fin; ending under dorsal fin in one specimen. Dorsal fin iv 7½ (n = 27*) or 8½ (n = 1); anal fin iii 5½ (n = 28*); pectoral fin 9 (n = 4) or 10 (n = 24*); pelvic fin 8 (n = 28*); caudal fin 9 branched rays in upper half (n = 28*), 7 (n = 2) or 8 (n = 26*) branched rays in lower half.

Lateral line and lateralis system canals on head accompanied by conspicuous supplementary neuromasts (Fig. 2). Supplementary neuromasts occur above and below the lateral-line pores and continue past the end of the lateral line, mostly in clusters of three or four (Fig. 2). Those on head occur mostly along canals. Cephalic lateral-line system with 6 (23), 7 (11) or 8 (1) supraorbital pores; 4+8 (5), 4+9 (20), 4+10 (8) or 4+11(2) infraorbital pores; 7 (1), 8 (1), 9 (4) or 10 (3) preoperculomandibular (countable on only 9 specimens); and 3 (35) supratemporal pores.

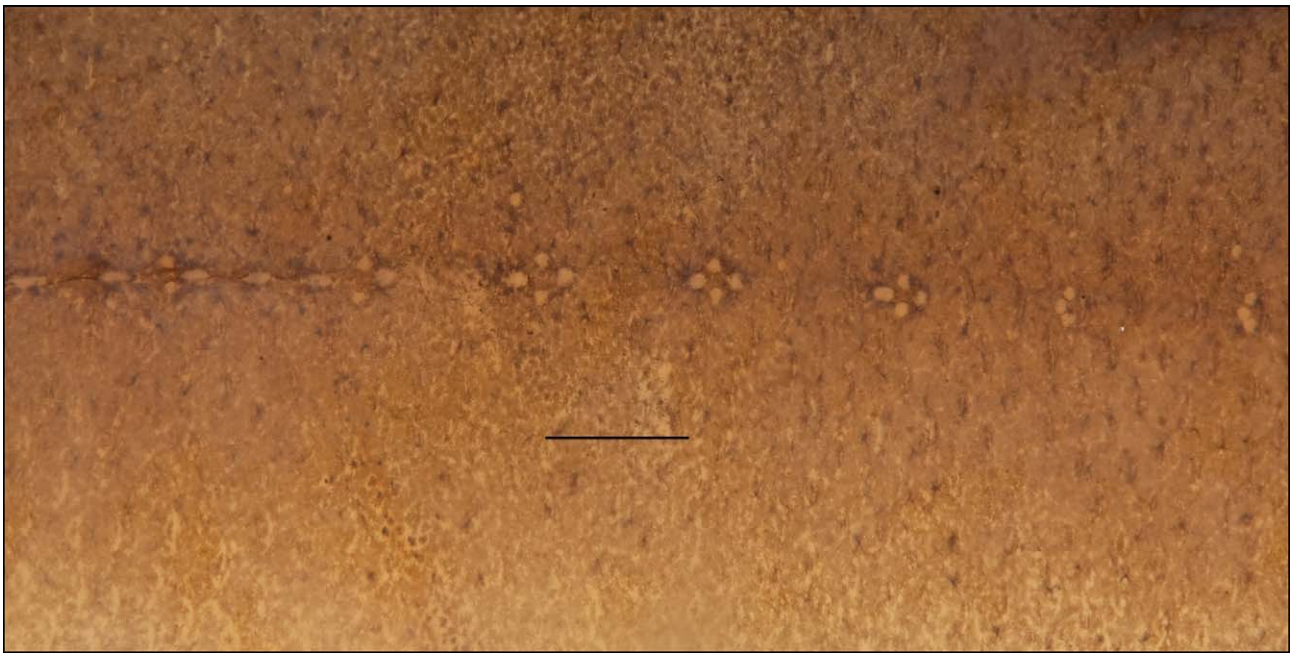

**FIGURE 2.** Midlateral view of *Schistura tenebrosa*, UF 181420, 45.9 mm SL. Scale bar = 1 mm. Lateral-line pores at left have supplementary neuromasts that continue in clusters beyond the end of the lateral line.

Lips moderately thick, pleated, covered with unculi; upper lip with very small median incision; lower lip with median interruption (Fig. 3). Processus dentiformis present. Inner rostral barbel reaching almost to corner of mouth; outer rostral barbel reaching to posterior nostril. Maxillary barbel reaching to or slightly past vertical at rear margin of eye. Barbels covered with unculi. Anterior nostril at base of long pointed flap reaching to eye. Intestine with bend just posterior to stomach, then turning sharply posterior (Fig. 4). No suborbital flap; no apparent sexual dimorphism.

**FIGURE 3.** Mouth of *Schistura tenebrosa*, UF 181418, 33.2 mm SL. Scale bar = 2 mm.

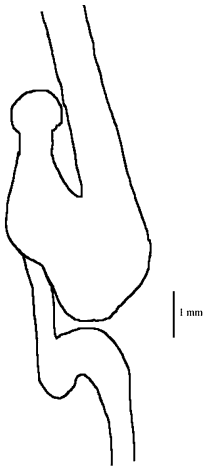


**FIGURE 4.** Digestive tract of *Schistura tenebrosa*, Burapha Univ. uncat., 42.6 mm SL female; Pakkok River, 4 December 2009. Scale bar = 1 mm.

**Color in life.** Head and body dark brown dorsally and on side; melanophores densely scattered over all of body except underside of head, breast, and midline of belly creating dusky brown appearance. Underside of head, breast, and belly cream-colored with few or no melanophores; some individuals with a concentration of melanophores on center of breast creating an amorphous blotch. Black preorbital bar extends onto snout nearly to nasal barbel. Barbels cream-colored, without melanophores except at bases.

Most specimens with faint black bar at base of caudal fin. Dorsal fin black at base, black extending up about one-third to one-half length of first ray; dorsal-fin rays lined with black, lighter toward edge of fin; black on rays often darkest in middle of fin creating dusky band. Other fins with melanophores along rays, interradial membranes hyaline. Often a small black spot at posterior end of upper procurrent rays of caudal fin. Characteristic color pattern of adult developed in smallest specimen examined (33.2 mm SL; Fig. 1). Specimens preserved in ethanol slightly lighter in color.

**Etymology.** The name, *tenebrosa*, Latin adjective for dark or gloomy, is in reference to the dusky color of this species.

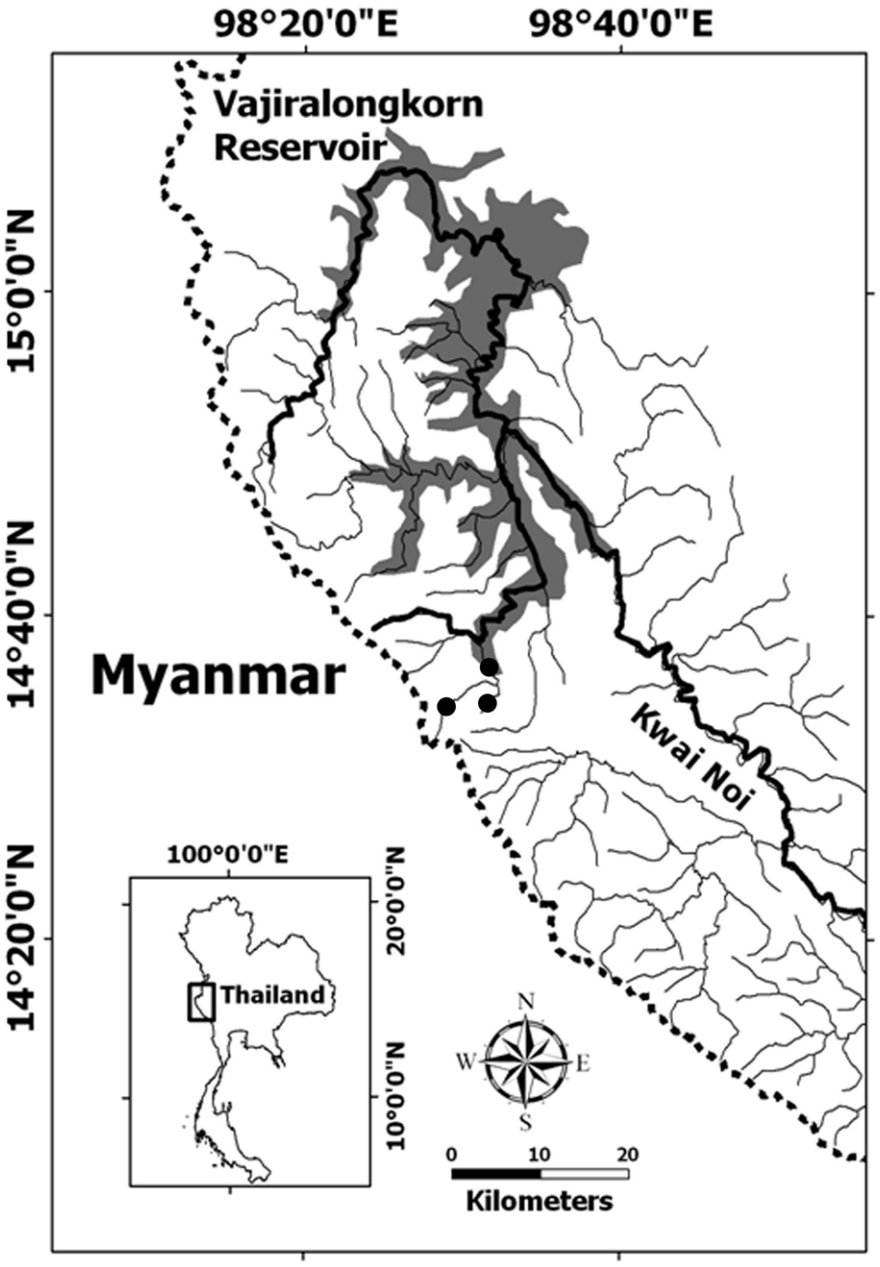


**FIGURE 5.** Distribution of *Schistura tenebrosa*. Black dots represent localities for specimens examined.

**Distribution and ecological notes.** *Schistura tenebrosa* is known only from the Kwai Noi, Mae Khlong basin, in the Thong Pha Phum District of Kanchanaburi Province, Thailand (Fig. 5). Most specimens have been found in rubble riffles (Fig. 6) in small streams in the upper reaches of the Pakkok River in the Kwai Noi system. A 45 mm SL female collected on 5 December 2009 had three chironomid larvae (Diptera) and a mayfly (Ephemeroptera) in its stomach and a parasitic nematode in its body cavity. The ovaries of this female and another from the same collection in December had only small ova in their ovaries.

Physical and chemical conditions where *S. tenebrosa* was captured varied as followed: elevation averaged 430 m asl, stream width was 4.8–7.2 m, depth varied from 18 to 40 cm, velocity varied from 15 to 48 cm/s, and the substrate consisted mostly of small to medium-sized rocks (1–13 cm). *Schistura tenebrosa* usually was captured where riparian vegetation cover was >50 percent and included mature deciduous trees, screw pines, bamboo, ferns, tall grasses, *Alocasias* sp. and a variety of other herbaceous plants. Water temperature varied seasonally from 23 to 26 ºC. Water pH averaged 7.0. Water chemistry varied little seasonally with oxygen at 8.2 to 8.5 mg/l, ammonia at 0 mg/l, and silica at 3.1–9.8 mg/l. Alkalinity was approximately 10–13 mg/l (pH 4.5).

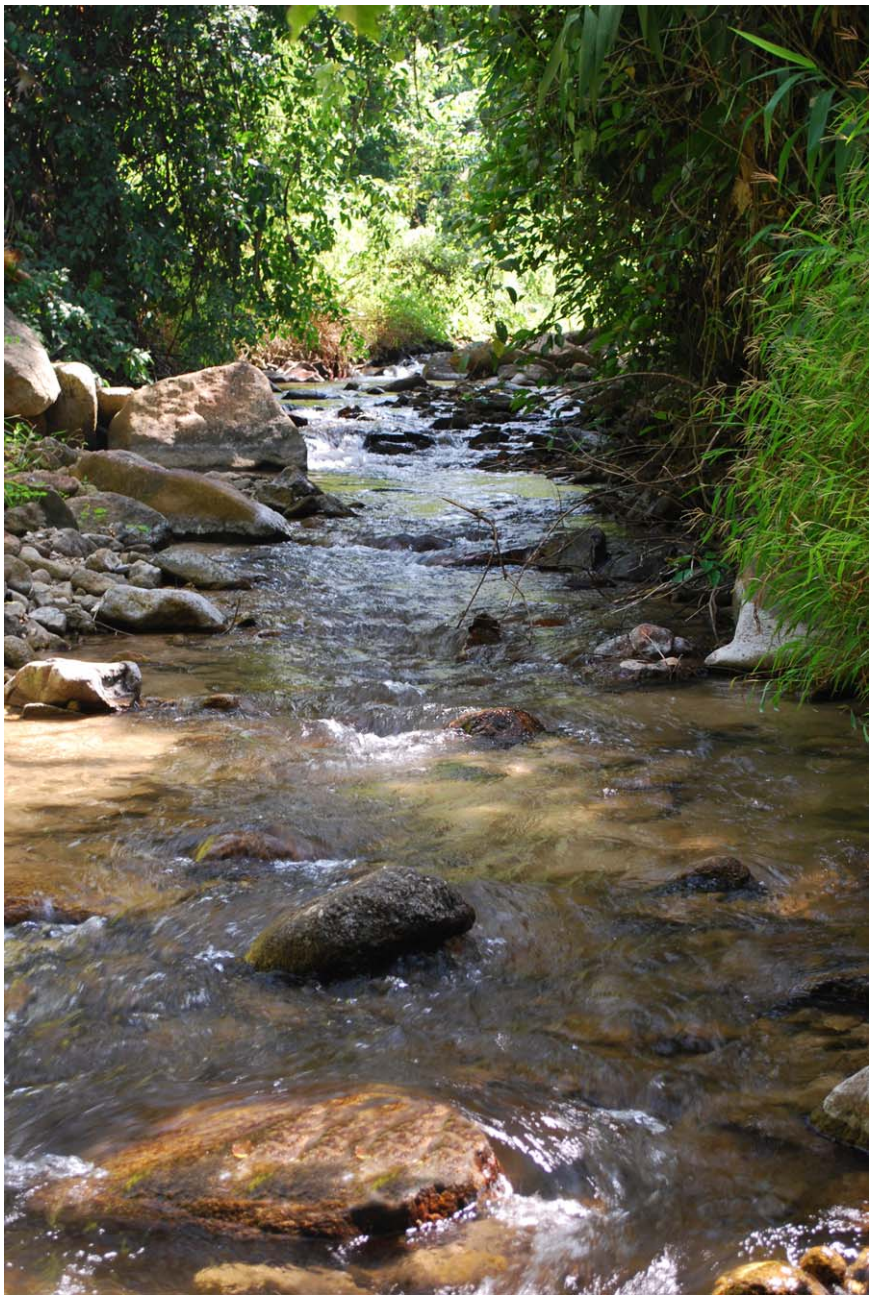

**FIGURE 6.** Habitat of *Schistura tenebrosa*. Pakkok River, 14º36'22' N, 98º28'14" E, Kanchanaburi Prov., 5 December 2009.

## Discussion

Phylogenetic relationships among the approximately 180 species of *Schistura* are poorly known and taxonomic comparisons are restricted to morphologically similar species. Three other species of *Schistura,* viz. *S. atra*, *S. russa*, and *S. suber* (Table 2), have been described as lacking marks on the back and side of the body and having a dusky appearance similar to that of *S. tenebrosa* (Kottelat 1998, 2000). *Schistura atra*, in the Nam Theun basin, Laos, is uniformly black in life, not brown as is *S. tenebrosa*, and has a complete lateral line (vs. ending before or under the dorsal fin), anterior nostril on the anterior side of a barbel-like pointed tube (vs. at base of long pointed flap), outer rostral barbel reaching to anterior margin of eye (vs. only to posterior nostril), 8½ branched dorsal-fin rays (vs. 7½) and 11–12 pectoral-fin rays (vs. 9–10). As in *S. tenebrosa*, conspicuous supplementary neuromasts occur on the head and above and below the first few lateral-line pores; however, they are absent along most of the lateral line.

**TABLE 2.** Characteristics of *Schistura tenebrosa* and phenotypically similar species lacking bars, stripes or other marks on the body. Data are from Kottelat (1998, 2000) and material examined. All species have an axillary lobe on the pelvic fin and lack a suborbital flap.

| | *S. tenebrosa* | *S. atra* | *S. russa* | *S. suber* |
|---|---|---|---|---|
| Lateral line | Incomplete; to dorsal fin | Complete | Incomplete; to anal fin | Complete |
| Dorsal-fin origin | Over pelvic-fin origin | Over pelvic-fin origin | In front of pelvic-fin origin | Over last pelvic-fin ray |
| Life color (dorsum and upper side) | Dark brown | Black | Russet brown | Yellow gray |
| Scales on nape and venter before pelvic fins | Absent | Absent | Absent | Present |
| No. branched dorsal rays | 7½ | 8½ | 8½ | 7½ |
| No. pectoral rays | 9–10 | 11–12 | 10–11 | 12 |
| No. pelvic rays | 8 | 8 | 7–8 | 7 |
| No. branched caudal rays: upper/ lower | 9/8 | 9/8 | 9/8 | 8/8 |
| Maximum SL | 46 | 51 | 49 | 30 |

*Schistura russa*, in the upper Nam Tha basin, Laos, is russet brown with some red on the upper part of the caudal fin (Kottelat 2000), has the lateral line extending to the anal fin (vs. ending before or under the dorsal fin), dorsal-fin origin in front of pelvic-fin origin (vs. above origin of pelvic fin), pelvic fin not reaching anus (vs. overlapping anus), a longer and more depressed head and snout, short flap on anterior nostril not reaching eye (vs. long pointed flap reaching eye), and 8½ branched dorsal-fin rays (vs. 7½). Conspicuous supplementary neuromasts are absent in *S. russa*.

*Schistura suber*, in the upper Nam Leuk basin, a tributary of the Nam Mang, Laos, differs from *S. tenebrosa* in being yellowish gray in life and in having a complete lateral-line fin (vs. ending before or under the dorsal fin), scales on nape and venter before pelvic fins (vs. no scales on nape and venter before pelvic fins), outer rostral barbel reaching to anterior margin of eye (vs. only to posterior nostril), and 8 upper caudal-fin rays (vs. 9). Conspicuous supplementary neuromasts are absent in *S. suber.*

*Schistura tenebrosa* is sympatric in the Mae Khlong basin with *Schistura aurantica* but is easily distinguished from it by lacking bars on the dorsum and side of the body and in having an axillary lobe at the base of the pelvic fin. It also occurs with *Schistura mahnerti* and *Schistura sexcauda*, but is easily separated from both by its uniform coloration, lack of a suborbital flap on the adult male, and in having a long pointed flap on the anterior nostril that

reaches to the eye. In *S. mahnerti* and *S. sexcauda*, the much shorter flap on the anterior nostril reaches only to the rear margin of the posterior nostril. In addition, *S. mahnerti* has a lateral line that is complete to the caudal fin with 88–101 pores (vs. incomplete, ending before or under the dorsal fin with 18–29 pores), and a larger size, to 59 mm SL. *Schistura sexcauda* modally has 8½ branched dorsal-fin rays (vs. 7½ in *S. tenebrosa*), a lateral line that is complete or reaching at least to the anal fin (vs. incomplete, ending before or under the dorsal fin with 18–29 pores), and reaches a much larger size, to 67 mm SL.

## Comparative material examined

*Schistura atra*: LAOS: NAM THEUN BASIN: ZRC 41792, holotype, 42.2 mm SL; Upper Nam Theun, 17°59'31"N, 105°27'49"E, 22 Mar. 1996.

*Schistura aurantiaca*: THAILAND: MAE KHLONG BASIN: KANCHANABURI PROV.: UF 178532, holotype, 36.3 mm SL; UF 176400, 2 ex., paratypes, 32.0–40.8 mm SL; Thong Pha Phum, Kwai Noi River system, Khayeng River at Route 3272 bridge, 14º39’35”N, 98º32’01”E, 3 Jan. 2010. UF 178529 1 ex., 35.9 mm SL; NIFI 3972, 2 ex., 35.9–35.9 mm SL; USNM 398673, 2 ex., 35.8–40.0 mm SL; ZRC 52053, 2 ex., 25.8–34.5 mm SL; Khayeng River, 14º33'22"N, 98º34'20"E, 6 Jun. 2010. UF 173048, 2 ex., 29.6–37.0 mm SL; Kwai Noi River, stream near km 32 on Route 323, 14º58’17”N, 98º38’24”E, 12 Jun. 2008. UF 173049, 1 ex., 31.8 mm SL; Lin Tin River, Route 323 at km 95, near Sai Yok, 14º33’44”N, 98º47’16”E, 12 Jun. 2008. UF 176388, 6 ex., 20.1–32.9 mm SL; Kring Ta Ko River, 14º45’10”N, 98º30’02”E, 2 Jan. 2010. UF 176447, 4 ex., 24.3–30.3 mm SL; Ban Rai River, near Tong Pha Phum, 14º43’10”N, 98º30’21”E, 2 Jan. 2010. UF 176461, 1 ex., 27.3 mm SL; Lin Tin River, Route 323 at km 95, 14º3216”N, 98º47’16”E, 1 Jan. 2010. UF 176575, 1 ex., 21.0 mm SL; Ban Rai River, near Tong Pha Phum, 14º42’49”N, 98º31’26”E, 2 Jan 2010. Burapha Univ. uncat., 15 ex., 31.9–39.5 mm SL; Khayeng River, 14º33’22”N, 98º34’20”E, 22 Apr. 2010. Burapha Univ. uncat., 10 ex., 31.3–39.7 mm SL; Khayeng River, 14º33’22”N, 98º34’20”E, 25 Apr. 2010.

*Schistura mahnerti*: THAILAND: SALWEEN RIVER BASIN: MAE HONG SON PROV.: NIFI 855, 1 paratype, 44.4; Mae Sahm Leap, Amphoe Mae Sariang; 22 Jan. 1981. NIFI 864, 15 paratypes, 17.5 –56.4; Mae Sariang River, Mae Sariang District, Amphoe Mae Sariang; 29 May 1978. TAK PROV.: NIFI 876, 8 paratypes, 24.8–28.0; Moei River, Ban Huai Pong, Amphoe Tha Song Yang; 10 Jun. 1981. USNM 288462, 6 paratypes, 21.5–55.6; mountain stream, 5 km W Mae Sariang, 29 Apr. 1973. MAE KHLONG BASIN: KANCHANABURI PROV.: NIFI 3056, 10 (of 14) ex., 32.3–54.8; Thung Yai Naresuan Wildlife Conservation Area; 4 Apr. 1996. NIFI 3082, 48 ex., 32.7–65.5; near Mae Khamin Waterfall; 4–5 Jan. 1998. UF 178531, 6 ex., 48.5–58.7; Khayeng River, near Tong Pha Phum, 14º33’22”N, 98º34’20”E, 25 May 2010. GULF OF THAILAND BASIN: PRACHUAP KHIRI KHAN PROV.: UF 178530, 4 ex., 53.1–74.0; Bang Sapan, 11º14’24”N, 99º21’27”E, 25 May 2010.

*Schistura russa*: LAOS: MEKONG BASIN: Louangnamtha Prov.: ZRC 45377, holotype, 49.2 mm SL; Nam Tha at Ban Finho, about 14 kilometers north of Luang Nam Tha, 21°04'44"N, 101°24°09"E, 22 May 1997. ZRC 45378 (2 paratypes), same data as holotype.

*Schistura sexcauda*: THAILAND: MAE NAM YOM BASIN: ANSP 68007, holotype, Me Poon, 94.0; 17º40'N, 99º42'E, 1936. MAE NAM PING BASIN: TAK PROV.: NIFI 878, 1 ex., 61.3; Huei Ban Na, Bhumbipol Dam; 20 Nov. 1973. NIFI 2185, 2 ex., 33.3–35.3; Nam Tok Lansang, 16º46'N, 99º01'E, Lansang National Park, Amphoe Muang, Sep. 1978. MAE KHLONG BASIN: KANCHANABURI PROV.: UF 176413, 3 ex., 27.1–34.7; Kwai Noi River, Khayeng River, hwy 3272 bridge, 14º39’35”N, 98º32’01”E, 3 Jan. 2010. USNM 295767, 13 ex., 21.0–27.0; Kwai Noi River between Kanchanaburi and Sai Yok, 13–14 Apr. 1973.

*Schistura suber*: LAOS: MEKONG BASIN: Vientiane Prov.: ZRC 45383, holotype, 29.7 mm SL; small forest stream along road from Thad Leuk to Nam Leuk dam site, 18°27'05"N, 103°04'06"E, 25 Feb. 1997.

## Acknowledgements

We gratefully acknowledge permission from the Thailand Department of Fisheries to collect specimens for this study, including permission to use electrofishing gear. We thank Chuntee Kongchaiya, Robert Beamish,

Thanapoomi Kongchaiya, Thidatath Klomklieng, Rungthip Plongsesthee, Patchara Nithirojpakdee, Weerapongse Tangjitjaroen, Randal Singer, Allison Schein and Sakda Arbsuwan for assistance in the field and the laboratory, and Zachary Randall for the photographs appearing in Figures 1, 2 and 3.

This project was supported in part by the Biodiversity Research and Training Program (BRT) and Center of Excellence on Environmental Health, Toxicology and Management of Chemicals (ETM), Faculty of Science, Burapha University, and by the U.S. National Science Foundation-funded All Catfish (DEB 0315963) and All Cypriniformes (DEB 1022720) Species Inventories. The National Science award, DEB 0845392, to David Reed provided the Visionary Digital (Palmyra, Virginia) system.

The following individuals and institutions provided loans of specimens and assistance during visits: Peter Ng and Kelvin Lim, Raffles Museum of Biodiversity, Singapore; Siriwan Suksri, National Inland Fisheries Institute, Bangkok; Jeff Williams, Jerry Finan, and Richard Vari, National Museum of Natural History, Smithsonian Institution, Washington; and Robert Robins and Randy Singer, University of Florida Museum of Natural History. Weerapongse Tangjitjaroen provided laboratory space at Chiang Mai University. Figure 5 is modified from a map graciously provided by Sampan Tongnunui. Anonymous reviewers provided helpful suggestions for improving the manuscript, and Jacqueline Webb provided helpful comments on the unusual lateralis system of this species.

## References

American Public Health Association (APHA). (1992) *Standard Methods for the Examination of Water and Wastewater, 18th Edition*. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C, 959 pp.

Bohlen, J. & Ŝlechtová, V. (2009) *Schistura udomritthiruji*, a new loach from southern Thailand (Cypriniformes: Nemacheilidae). *Ichthyological Exploration of Freshwaters*, 20, 319–324.

Bohlen, J. & Ŝlechtová, V. (2011) A new genus and two new species of loaches (Teleostei: Nemacheilidae) from Myanmar. *Ichthyological Exploration of Freshwaters*, 21, 1–10.

Freyhof, J. & Serov, D.V. (2001) Nemacheiline loaches from Central Vietnam with descriptions of a new genus and 14 new species (Cypriniformes: Balitoridae). *Ichthyological Exploration of Freshwaters*, 12, 133–191.

Kottelat, M. (1990a) *Indochinese nemacheilines: A revision of nemacheiline loaches (Pisces: Cypriniformes) of Thailand, Burma, Laos, Cambodia and southern Viet Nam*. Pfeil, München, 262 pp.

Kottelat, M. (1990b) New species and populations of cave nemacheilines in South and Southeast Asia (Osteichthyes: Balitoridae). *Mémoires de Biospéologie*, 17, 4956.

Kottelat, M. (1998) Fishes of the Nam Theun and Xe Bangfai basins, Laos, with diagnoses of twenty-two new species (Teleostei: Cyprinidae, Balitoridae, Cobitidae, Coiidae and Odontobutidae). *Ichthyological Exploration of Freshwaters*, 9, 1–128.

Kottelat, M. (2000) Diagnoses of a new genus and 64 new species of fishes from Laos (Teleostei: Cyprinidae, Balitoridae, Bagridae, Syngnathidae, Chaudhuriidae and Tetraodontidae). *Journal of South Asian Natural History*, 5, 37–82.

Kottelat, M. (2004) *Schistura spekuli*, a new species of cave fishes from northern Vietnam (Teleostei: Balitoridae). *Ichthyological Exploration of Freshwaters*, 15, 187–191.

Nguyen, V.H. (2005) *Ca Nuoc Ngot Viet Nam.* Tap II. [*Freshwater fishes of Vietnam*]. Ca nuoc ngot Viet Nam. Tap II v. 2, 760 pp.

Nguyen, X.K. & Nguyen, H.D. (2007) A new species of genus *Schistura* from Pu Mat National Park, Nghe An Province, Vietnam. *Tap Chi Sinh Hoc* [Journal of Biology], 29, 17–21.

Ou, C., Montaña, C.G., Winemiller, K.O. & Conway, K.W. (2011) *Schistura diminuta*, a new minature loach from the Mekong River drainage of Cambodia (Teleostei: Nemacheilidae). *Ichthyological Exploration of Freshwaters*, 22, 1193–200.

Plongsesthee R., Page, L.M. & Beamish, W. (2011) *Schistura aurantiaca*, a new species from the Mae Khlong basin, Thailand (Teleostei: Nemacheilidae). *Ichthyological Exploration of Freshwaters*, 22, 169–178.

Tongnunui, S. & Beamish, F.W.H. (2009) Habitat and relative abundance of fishes in small rivers in eastern Thailand. *Environmental Biology of Fishes*, 85, 209–220.

Vidthayanon, C. (2003) *Schistura pridii*, a new nemacheiline loach (Teleostei: Balitoridae) from Upper Chao Phraya drainage, northern Thailand. *Ichthyological Exploration of Freshwaters*, 14, 307–310.

Vidthayanon, C. & Jaruthanin, K. (2002) *Schistura kaysonei*, (Teleostei: Balitoridae) a new cave fish from the Khammouan karst, Laos PDR. Aqua, *Journal of Ichthyology and Aquatic Biology*, 6, 17–20.

Vidthayanon, C. & Kottelat, M. (2003). Three new species of fishes from Tham Phra Wang Daeng and Tham Phra Sai Ngam caves in northern Thailand (Teleostei: Cyprinidae and Balitoridae). *Ichthyological Exploration of Freshwaters*, 14, 159–174.